The Amer. S. S. *Carrillo* at 7 a. m. (E. S. T.) of June 12, near latitude 18.7° N. and longitude 86.6° W. reported a barometer reading of 29.77 inches; east-southeast winds, force 5; slight drizzle, with rough sea. At 7 a. m. (E. S. T.) of the following day, the *Carrillo*, then in the easterly quadrant of the disturbance, encountered east and southeast winds of force 7–8 accompanied by very rough seas.

The center of the depression, by evening of June 12, was near Cozumal Island, where there had been a fall in pressure from 29.88 inches at the morning observation, to 29.61 inches at 7 p. m. (E. S. T.).

During the period from the morning of June 12 until the evening of June 14 the disturbance moved slowly northward.

The Pan American Airways Observer at San Julian, located on the extreme western tip of Cuba, reported south wind, force 7, with a rainfall of 10 inches, during the night of June 12–13. On the morning of the 13th, the S. S. *Alabama*, near latitude 25.3° N. and longitude 85.8° W., recorded a falling barometer; fresh gales from the east-southeast and southeast, with overcast skies and rain. By noon the wind had increased from force 8 to force 9; this was the highest wind reported in connection with this disturbance. The lowest barometer reading during the progress of the disturbance (29.54 inches) was observed on the evening of June 14, on the American Steamship *Kofresi*, near latitude 29.5° N. and longitude 87.6° W. This vessel reported that during that period she met with heavy rain squalls, moderate gales, and rough seas.

During the 24 hours following the evening of the 14th, the center of the disturbance described a small left-hand loop, then resumed a north-northwestward movement on the night of June 15, which carried the depression inland, over Mobile, Ala., on the morning of the 16th.

The explanation of this loop by R. A. Dyke, Forecaster in charge of our New Orleans Office, is as follows:

> The westward turn at the beginning of the loop early on the night of the 14th–15th was attended by a tendency toward equalization of pressure along the coast north of the disturbance. The pressure at Pensacola rose from 29.66 at 7:30 p. m. (E. S. T.) of the 14th to 29.68 at 9 p. m., while the pressure at Mobile fell from 29.74 to 29.70 inches. However, instead of movement to the coast, as expected, the disturbance continued to move in a small curve which brought it slightly farther south on the morning of the 15th.
>
> Until the movement of the disturbance was halted off Pensacola, the straight northward progress was evidently under the influence of upper winds in line with those over Florida, where the western portion of an upper anticyclonic circulation gave upper winds from the south. The northward drift prevailed as far west as New Orleans up to 14,000 feet on the 12th.
>
> With northward advance the winds aloft from Florida westward to New Orleans came under the influence of the disturbance. At the same time the winds aloft from 8,000 to 14,000 feet were moving anticyclonically over Texas and the Lower Mississippi Valley. The center of this upper anticyclonic circulation moved east-northeastward from Texas and Oklahoma to eastern Kentucky, or thereabouts, from the 14th to the 16th, and the upper winds over the Lower Mississippi Valley became easterly instead of northeasterly, except over New Orleans, where winds in the afternoon of the 15th were northeast up to 27,000 feet, with the upper winds showing velocities of 30 to 42 miles per hour. In the early morning of the 16th, the upper winds at elevations of 8,000 to 12,000 feet from Montgomery, Ala., to Memphis, Tenn., and Little Rock, Ark., had veered to southeasterly, while winds over New Orleans, under the influence of the disturbance, had backed to northerly. During the shift of the center of the upper anticyclonic circulation from the Southern Plains to a more eastern position the northward movement of the disturbance was halted by blocking winds; but when the upper circulation became central farther east the upper winds favored the resumption of northward movement. Indeed, the blocking winds apparently forced the disturbance farther southward so as to form the small loop described.

At Mobile, Ala., at 9:37 a. m. (E. S. T.) of June 16, as the center moved inland, an abrupt wind-shift from north to south was observed. The wind was of only moderate force. At 7:30 p. m. (E. S. T.) of the 16th, its center lay to the southwest of Meridian, Miss.; the disturbance thereafter advanced to the northward, and merged with an extra-tropical LOW pressure area.

There was no loss of life reported in connection with this disturbance, except that a boy fell into the swollen waters of the Peace River near Wauchula, Fla., and was drowned.

The first advisory in connection with this disturbance was issued from the Weather Bureau Office at Jacksonville, Fla., at 9:30 p. m. (E. S. T.) of June 12, and as the depression passed through the Gulf of Mexico, frequent timely warnings and advisories were issued from New Orleans, La.

Chart XIII, shows the situation on the morning of June 13, and the track of the disturbance.

THE CHAMPLIN-ANOKA, MINNESOTA, TORNADO

By M. R. HOVDE

[Weather Bureau, Minneapolis, Minn., June 1939]

On Sunday afternoon, June 18, 1939, between 3 and 4 p. m., a destructive tornado crossed the northwestern portion of Hennepin County and entered southern Anoka County. Several villages and the small city of Anoka were in the path of the funnel-shaped cloud; and death, injuries, and destruction were left in its wake.

The towns of Champlin and Anoka, center of greatest damage, are located on the Mississippi river, 17 miles north of Minneapolis. The combined population of 5,000 is practically all centered in Anoka, which is on the east bank of the river; the small village of Champlin is on the west bank.

The studies of Finley, Henry, and the Climatological Service of the Weather Bureau indicate that 122 tornadoes have occurred within the limits of Minnesota during 40 years of record, an annual average of 3. The Champlin-Anoka storm must be placed among the most disastrous 10 in loss of life and value of property destroyed.

The tornado was first observed southwest of Corcoran in Hennepin County and traveled in a northeasterly course through Maple Grove, Champlin, Anoka, and Cedar, a distance of 25 miles. The storm struck Anoka at 3:20 p. m. and its last fury was spent in Cedar at 3:38 p. m. These times indicate a speed of translation of about 30 miles per hour.

The occurrence of the storm can best be explained by the convective instability of the air that prevailed over this region during the 18th. At 6:30 a. m. C. S. T. that morning, a disturbance was centered over eastern North Dakota. Tropical maritime air has been transported northward into western and southern Minnesota. About 2 kilometers above this moist air was a Superior air mass overrunning from the southwest. As shown by the meteorograph sounding made at Fargo, the lapse rate of this Superior air was almost the dry adiabatic. When this sounding was plotted on the Rossby diagram it showed that the atmosphere in the warm sector of this disturbance was extremely convectively unstable. In fact, a layer of air would have had to be lifted only a little more than 1 kilometer to realize absolute instability.

This amount of lifting could have been easily accomplished by the steep and very distinct cold front that moved eastward through Minnesota that afternoon. Thunderstorms were numerous in the east-central counties and were attended by severe hail and excessive precipitation in many localities. The tornado was an attendant to one of these storms.

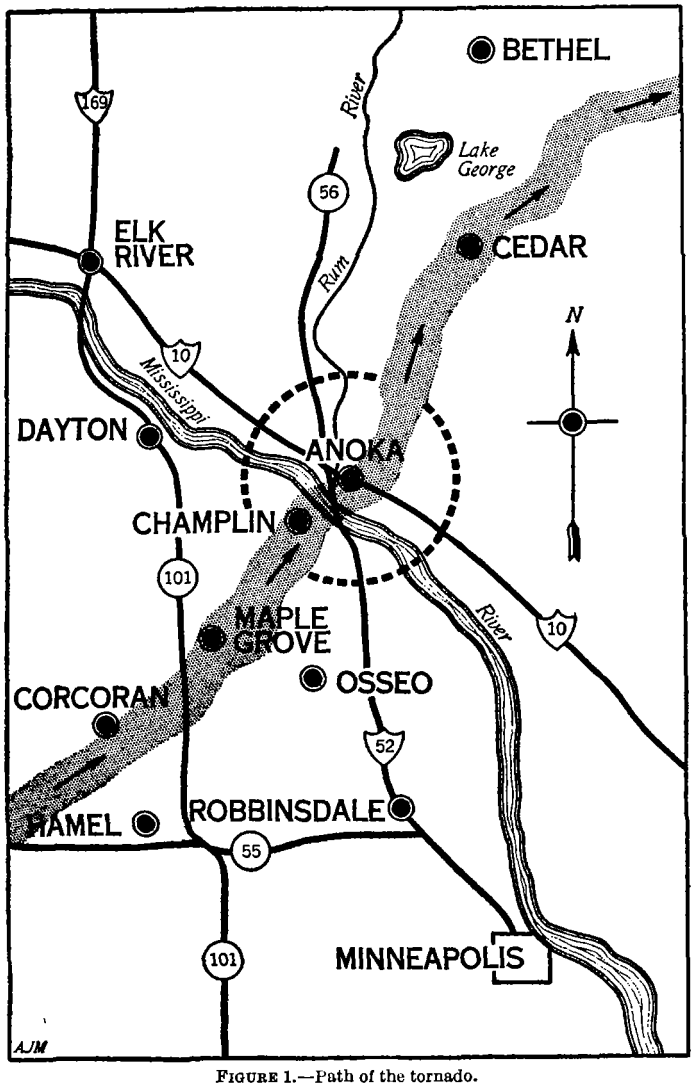

FIGURE 1.—Path of the tornado.

Debris was carried as high as 300 feet and small articles of furniture, clothing, and papers were picked up in various places 50 to 70 miles distant.

The first destruction and fatalities occurred near Corcoran where four dwellings were demolished and four persons met death when their automobile was thrown 1,000 feet and smashed to pieces. In the Maple Grove district, seven farmhouses were damaged or destroyed. The tornado continued its northeasterly course to Champlin where several houses were completely demolished; 1 death and 30 injuries resulted. The storm now crossed the Mississippi river and many witnesses saw the river "dry up" as the waters were lifted and wind velocities were so great as to prevent the flow and the return of water until the funnel cloud had reached the opposite bank. Entering Anoka at Second Avenue the tornado cloud moved up Third Avenue and cut a diagonal swath three blocks wide through the city, leveling houses, trees, and buildings. According to a survey by the *Anoka Union Newspaper*, 240 families and 1,450 persons were affected by this disaster.

The State militia took charge of policing Anoka and remained on duty until June 26. Traffic through the city was resumed a week after the storm when 25,000 automobiles and 100,000 persons visited the scenes of destruction.

The table gives the frequency of tornadoes, tornado deaths, and property losses for early periods in Minnesota and for the past 15 years. From this tabulation it will be seen that this tornado was a major disaster; it caused 9 deaths, 222 injuries, and $1,200,000 property damage.

Tornadoes in Minnesota

[Frequency of tornadoes, tornado deaths, and property losses]

Year or period	Number of tornadoes	Loss of life from tornadoes	Aggregate reported property losses
1874–81	21	[1]	[1]
1889–97	26	35	$595,000
1916–23	12	99	4,767,000
1924	2	3	500,000
1925	3	0	137,500
1926	0	0	
1927	2	0	100,500
1928	5	6	1,190,000
1929	4	8	1,460,000
1930	5	1	235,000
1931	2	2	212,000
1932	2	0	700,000
1933	0	0	
1934	5	1	929,200
1935	[2] 15	3	673,700
1936	5	3	891,000
1937	5	1	212,500
1938	7	0	546,000
1939 [3]	[4] 1	[5] 9	[6] 1,200,000

[1] Unknown.
[2] Tornado character doubtful in 7 storms.
[3] For 6 months, January–June, inclusive.
[4] Champlin-Anoka tornado of June 18.
[5] 222 persons injured.
[6] Estimate of disaster committee.

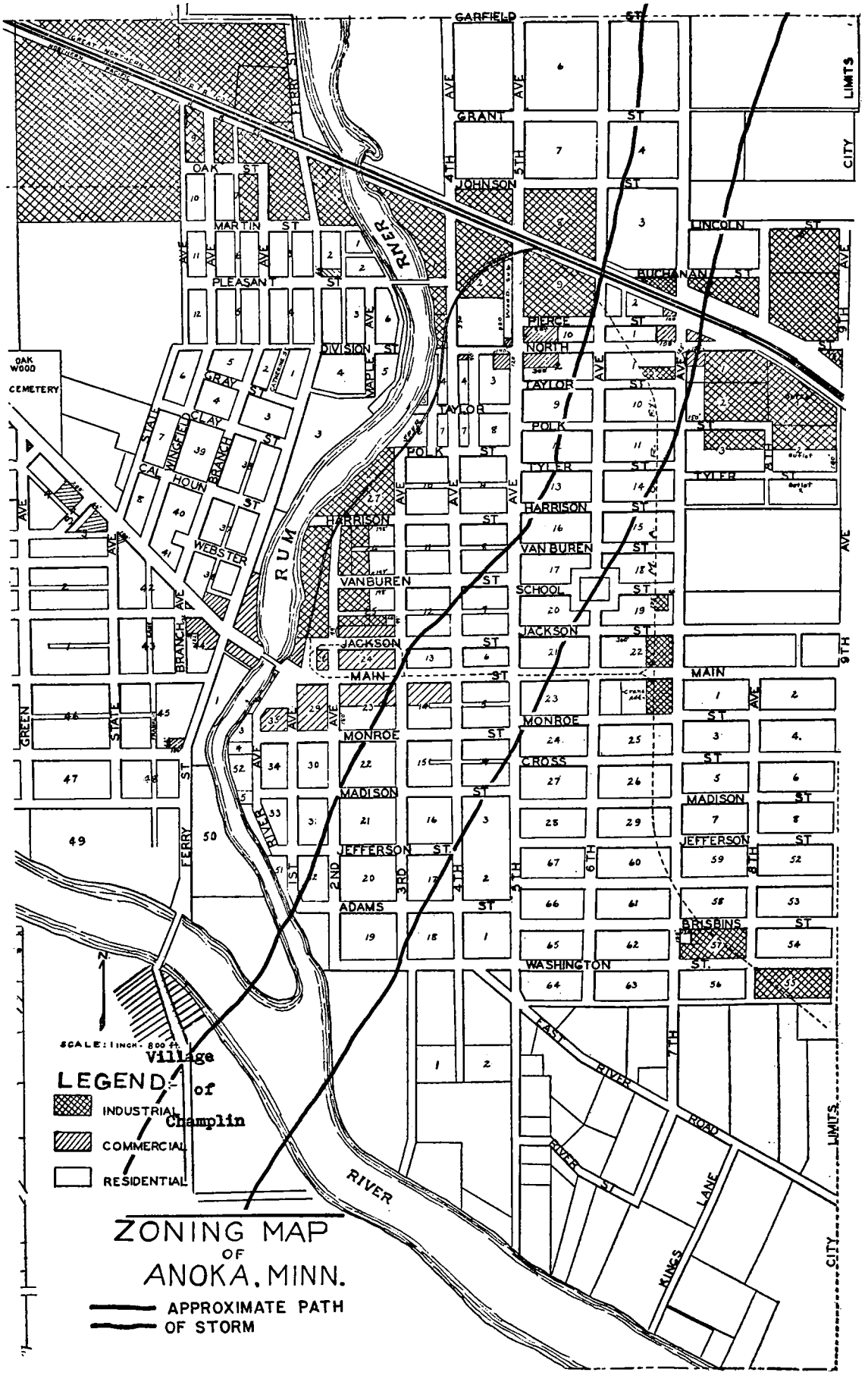

FIGURE 2.—The section of Anoka, Minn., traversed by the tornado.